

IN THE CLAIMS

The pending claims are set forth as follows.

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1. (Original) A method for determining one or more new gains for a controller while the controller continues to control a process towards a target loop transfer function, the controller receiving a process output signal and a process set point signal and providing a process input control signal, the method comprising the steps of:
 - introducing a disturbance into the process input control signal;
 - calculating one or more new gains for the controller using a controller output signal, the process input control signal, and the target loop transfer function; and
 - using the one or more new gains in the controller to subsequently control the process.
 2. (Original) The method of claim 1, wherein the one or more new gains for the controller are determined without using a model of the process.
 3. (Original) The method of claim 1, wherein said gains include a proportional gain.
 4. (Original) The method of claim 1, wherein said gains include an integral gain.
 5. (Original) The method of claim 1, wherein said gains include a derivative gain.
 6. (Original) The method of claim 1, wherein the target loop transfer function is indicative of a desired response of the process.
 7. (Original) The method of claim 6, wherein the target loop transfer function is a first-order transfer function.
 8. (Original) The method of claim 6, wherein the target loop transfer function is a second-order transfer function.

9. (Original) The method of claim 1, wherein the process is controlled within a desired closed-loop control bandwidth.
10. (Original) The method of claim 9, wherein the desired closed-loop control bandwidth is indicative of a desired settling time for the process.
11. (Original) The method of claim 9, wherein the desired closed-loop control bandwidth is indicative of a time constant for the process.
12. (Original) The method of claim 1, wherein the disturbance includes one or more step changes.
13. (Original) The method of claim 1, wherein the disturbance includes a pseudo random binary sequence.
14. (Original) The method of claim 1, wherein the disturbance includes a white noise signal that is band-pass filtered and clipped.
15. (Original) The method of claim 1, wherein the disturbance is introduced into the controller output signal causing a response in the process input control signal.
16. (Original) The method of claim 1, wherein the controller uses the one or more new gains to produce the controller output signal.
17. (Original) The method of claim 16, wherein the controller output signal comprises a proportional error.
18. (Original) The method of claim 16, wherein the controller output signal comprises an integral error.

19. (Original) The method of claim 16, wherein the controller output signal comprises a derivative error.
20. (Original) The method of claim 1, wherein the process input control signal is the sum of the controller output and the disturbance.
21. (Original) The method of claim 1, wherein the new gains for the controller are calculated such that the sum total of the controller output and the product of the process input control signal and the target loop transfer function is minimized.
22. (Original) The method of claim 21, wherein the sum total is minimized by curve fitting said sum total using recursive least squares technique.
23. (Original) The method of claim 21, wherein the sum total is minimized by curve fitting said sum total using recursive least squares technique with one or more constraint.
24. (Original) The method of claim 23, wherein the recursive least squares technique constraint comprises positive values for the one or more new gains for the controller.
25. (Original) A tuning device for tuning one or more new gains of a controller while the controller controls a process towards a target loop transfer function, the controller receiving a process output signal and a process set point signal and providing a process input control signal, the gain tuning device comprising:
disturbance generating means for generating a disturbance in the process input control signal;

calculating means for calculating one or more new gains of the controller using a controller output signal, the process input control signal, and the target loop transfer function; and

providing means for providing the one or more new gains to the controller, whereby the controller uses the new gains to subsequently control the process.

26. (Original) A method for determining one or more new gains for a controller while the controller continues to control a process towards a target loop transfer function, the controller receiving a process output signal and a process set point signal and providing a controller output signal, the method comprising the steps of:

introducing a disturbance into the controller output signal causing a response in a process input control signal;

calculating one or more new gains for the controller using the controller output signal, the response in the process input control signal, and the target loop transfer function; and

using the one or more new gains in the controller to subsequently control the process.

27. (Original) A tuning device for tuning one or more new gains of a controller while the controller controls a process towards a target loop transfer function, the controller receiving a process output signal and a process set point signal and providing a controller output signal, the gain tuning device comprising:

disturbance generating means for generating a disturbance in the controller output signal causing a response in a process input control signal;

calculating means for calculating one or more new gains of the controller using the controller output signal, the response in the process input control signal, and the target loop transfer function; and

providing means for providing the one or more new gains to the controller, whereby the controller uses the new gains to subsequently control the process.
